(12) UK Patent Application (19) GB (11) 2 229 513 (13) A

(43) Date of A publication 26.09.1990

(21) Application No 9003204.6

(22) Date of filing 13.02.1990

(30) Priority data
(31) 3904866 (32) 17.02.1989 (33) DE

(51) INT CL[5]
F16F 9/49

(52) UK CL (Edition K)
F2S SBF S102 S111 S114 S121 S302 S307
U1S S1820 S1855

(56) Documents cited
GB 2150261 A GB 2092707 A GB 0972311 A
GB 0548943 A DE 2905030 B

(58) Field of search
UK CL (Edition J) F2S SBF
INT CL[4] F16F

(71) Applicant
Fritz Bauer & Söhne oHG

(Incorporated in the Federal Republic of Germany)

Industriestrasse 12-14, D-8503 Altdorf,
Federal Republic of Germany

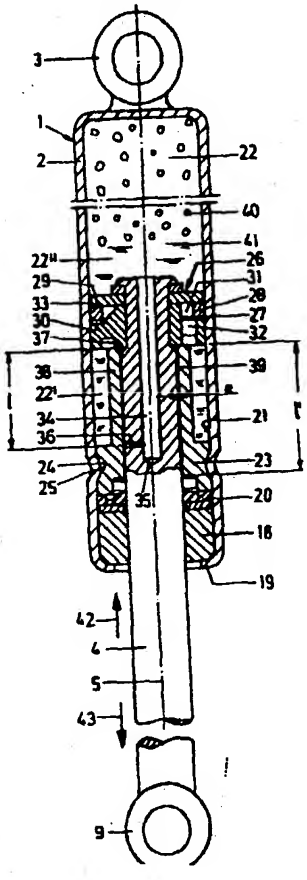
(72) Inventors
Hans-Peter Bauer
Hans-Jurgen Bauer
Ludwig Stadelmann

(74) Agent and/or Address for Service
Jensen & Son
8 Fulwood Place, High Holborn, London, WC1V 6HG,
United Kingdom

(54) Gas spring

(57) A gas spring with end position damping, for a hinged panel such as a boot lid has a cylindrical housing (2) filled partly with pressurised gas (40) and partly with oil (41), in which a piston rod (4) is sealingly displaceable out of one end of the housing (2). Rod (4) carries a piston (26), passages therethrough closing on the outward extension of the rod (4) out of the housing (2) and opening on the inward displacement or retraction. A longitudinal channel (34) bridges the piston (26) connecting together the partial inner spaces (22', 22") of the housing (2) situated on both sides of the piston (26), said longitudinal channel being connected by means of a throttle channel (36) with the partial inner space (22'). A device for damping the outward movement of the piston rod (4) is formed by a throttle bush (38) into which the throttle channel (36) extends in the region of the end of the outward displacement of the piston rod (4) out of the housing (2), a throttle annular space (39) being provided between the piston rod (4) and the throttle bush (38).

FIG. 2



GB 2 229 513 A

FIG.1

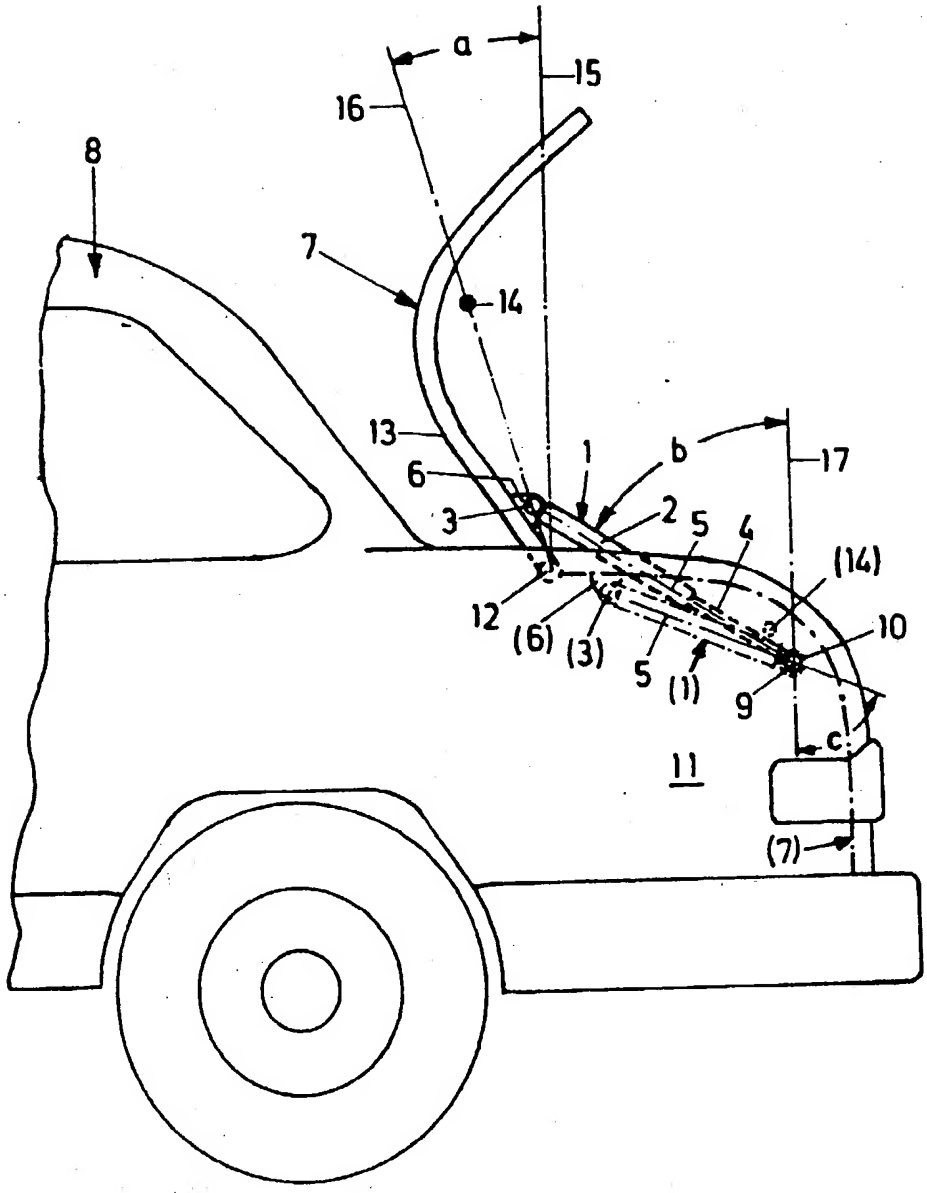


FIG. 2

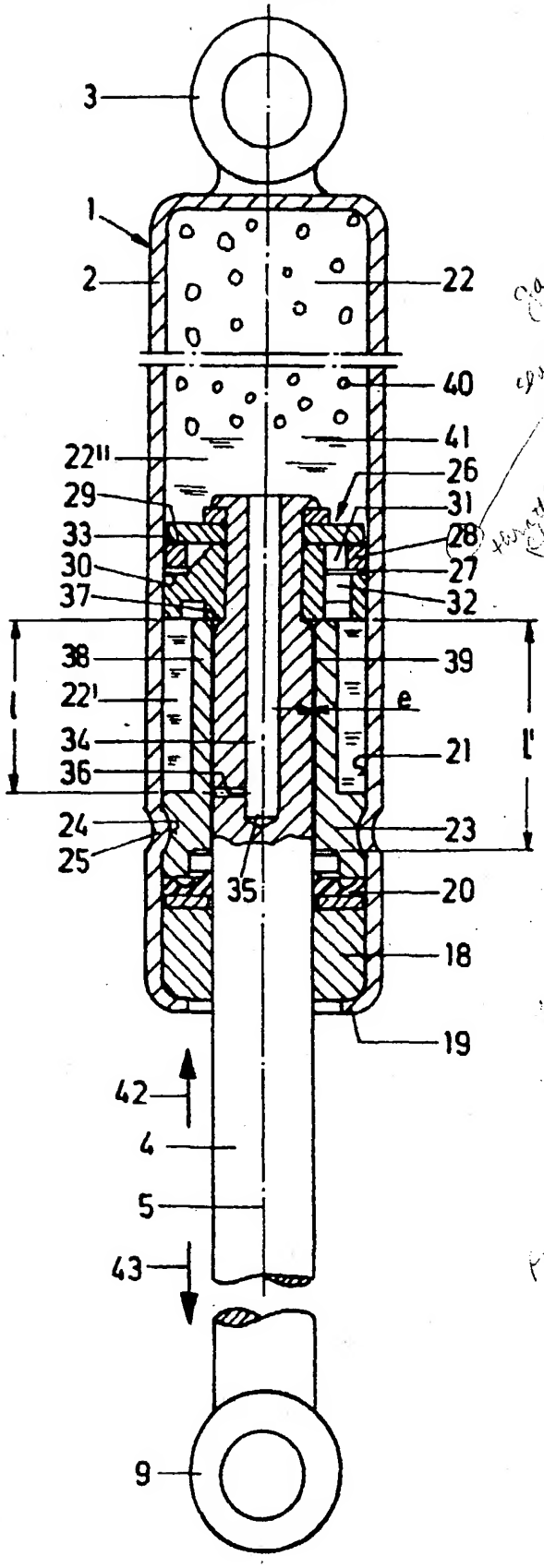
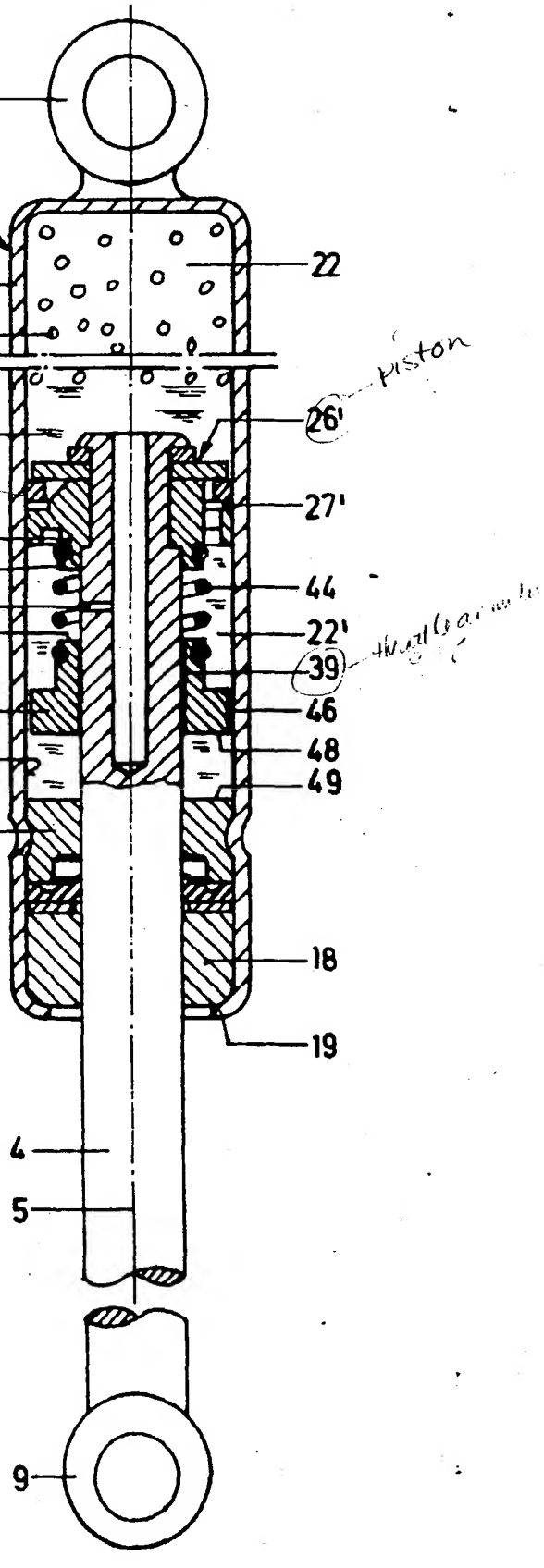

3
1
2
22
40
41
22''
26
29
31
33
28
30
27
37
32
38
39
22'
e
34
21
36
l'
24
23
25
35
20
18
19
42
4
5
43
9

FIG. 3


3
1
2
22
40
piston
41
26'
27'
37'
45
44
36
47
22'
39
38'
46
21
48
49
23
18
19
4
5
9

A Gas Spring, for use as a Lifting Aid for Hinged Panels, such as a Vehicle Luggage Boot Lid

The invention relates to a gas spring with end position damping, for use as an aid to lifting, for example, a hinged panel such as the boot lid of a motor vehicle luggage compartment and comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing, on the inner end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement

In a gas spring of this type known from German Auslegeschrift AS 29 05 30 there is arranged at the piston rod output end a chamber into which the throttle channel plunges on the outward run of the piston rod. The piston itself exerts a so-called drawing action onto the oil present in the inner space of the housing and therefore takes this along on the outward run of the piston rod in front of the latter's output side end. Here, a throttling port is provided through which the oil flows into the chamber producing a considerable additional damping. The oil then flows through the throttle channel and the longitudinal hole in the piston rod into the partial inner space of the housing situated opposite the piston rod output side end. So that this end damping remains effective on each outward run of the

piston rod, it is necessary that preliminarily the piston rod should be again fully driven into the housing so that the oil can again flow against gravity in the partial inner space facing the piston rod output side end. This gas spring is used in such a manner that the piston rod is always upwardly driven out.

The present invention seeks to provide a gas spring of the above-described type in such a manner that a reliable end damping is achieved with simple means and also when the piston rod is driven out downwards when the gas spring is used.

According to the invention, there is provided a gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing, on the inner end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel extends in the region of the end of the outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

The throttling port of the longitudinal channel plunges at the end of its outward run into the throttle bush and produces an additional hydraulic damping.

In one embodiment of the invention, the throttle bush is stationarily mounted in the housing. In another embodiment

of the invention, the throttle bush is connected with the piston by means of a tractive connection.

In a further embodiment of the invention, the throttle bush is connected with the piston by means of a helical spring and the throttle channel, when the helical spring is released, opens out into the partial inner space between the piston and the throttle bush. In yet another embodiment of the invention, the throttle bush delimits, with the inner wall of the housing, a throttling channel. These aspects of the invention make it possible, with relatively reduced expenditure, to achieve a multi-step end damping without the throttle bush having to be specially long for the purpose.

The invention further provides for the utilisation of a gas spring as a lifting aid for a hinged panel mounted on and able to be upwardly pivoted around a joint, the piston rod being downwardly directed in all pivoting positions of the hinged panel with respect to the housing.

In an advantageous aspect of the invention, the central longitudinal axis of the gas spring, when the hinged panel has been pivoted upwardly, encloses an angle in a vertical plane which is less than 65° and in another aspect of the invention, the centre of gravity of the hinged panel, on the upward pivoting thereof, is pivoted through a vertical plane passing through the joint of the panel. In still a further aspect of this invention, the throttle channel extends into the throttle bush when the centre of gravity of the hinged panel is pivoted through the vertical plane.

In yet another aspect of the invention, the housing is filled with an amount of oil such that the partial inner space situated between the piston and the piston rod output side end of the housing is at least substantially filled with oil if the throttle channel extends into the throttle bush.

The invention further provides for the utilisation of a gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing and on the inner end of the piston there are

disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel extends in the region of the end of the outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

The invention additionally provides a motor vehicle having a compartment closable by means of a hinged panel which is upwardly pivotable about a joint assisted by a gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing, on the inner end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel extends in the region of the end of the

outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

Two embodiments of the invention will now be described, by way of examples and with reference to the accompanying drawings, in which:

Fig. 1 is the back of a motor vehicle which shows the use of a gas spring of the invention;

Fig. 2 is a gas spring of the invention in longitudinal section, and

Fig. 3 is a modified embodiment of a gas spring of the invention in longitudinal section.

As shown in the Figures, a gas spring 1 has a substantially cylindrical housing 2 on the one gas-tight end of which a knuckle eye 3 is mounted as securing element.

Out of the other end of the housing 2 a piston rod 4 is led out which is mounted concentrically with the central longitudinal axis 5 of the housing 2 in slidable manner. The gas spring 1, together with its knuckle eye 3, is articulated at a joint 6 on a lid 7 of a motor vehicle 8 constructed as a boot lid.

The free end of the piston rod 4 also has a knuckle eye 9 acting as a securing element, by means of which it is articulated in a joint 10 in the boot 11 of the motor vehicle 8. The deck lid 7 is, for its part, articulated on the boot 11 by means of a joint 12.

As will be seen in Fig. 1 the boot lid 7 is so articulated that its upper side 13, when the boot 11 is closed, is situated in a substantially horizontal position, as shown in a dash-dot line in Fig. 1. Its centre of gravity 14 is here still under the joint 12. As Fig. 1 further shows, the centre of gravity 14, when the boot lid 7 is open, and seen from its closed position, is behind a vertical plane 15 through the joint 12. The angle a between this vertical plane 15 and a connecting line 16 through the centre of gravity 14 and the joint 12 is, for example, between about 20° and 30°. The angle b between the axis 5 of the gas spring 1 and a vertical plane 17 through the joint 10 when

the boot lid 7 is open is for example between about 50° to 65°. As Fig. 1 furthermore shows, the angle ε between the axis 5 and the vertical plane 17 when the boot lid is closed is even greater; it is about 70° to 80°.

At the piston rod output side end of the housing 2 a guide bush 18 is provided, (Figure 2), which guides the piston rod 4 coaxially; this guide bush is held outwardly by a bead 19 of the housing 2. Applying against this guide bush 18 is a seal 20 which lies on the one hand sealingly against the inner wall 21 of the housing 2 and on the other hand sealingly against the piston rod 4, so that the gas spring is closed off in gas-tight manner at its piston rod output side end.

Towards the inner space 22 of the housing 2 there connects onto the seal 20 a holding ring 23 which is axially held by a bead 25 rolled into the housing 2 and engaging into a corresponding circumferential groove 24 of the holding ring 23.

Mounted on the end of the piston rod 4 which is situated in the housing 2 is a so-called damping piston 26 which has an annular space 27 open towards the inner wall 21 of the housing 2 in which there is disposed a damping ring 28 bearing against the inner wall 21 and which is in a highly wear-resistant plastic, e.g polytetrafluorethylene (PTFE). The annular space 27 is delimited in the axial direction by two limiting surfaces extending radially towards the axis 5 and acting as stop faces 29, 30, the distance of which in the direction of the axis 5 is to some extent greater than the extension of the damping ring 28 in this direction, so that the damping ring 28 is able to move in the direction of the axis 5 slightly relative to the piston 26.

Radially inside the damping ring 28 there is formed in the annular space 27 a free space 31 into which a passage duct 32 opens out into the partial annular space 22' which is situated between the damping piston 26 and the piston rod output side end of the gas spring 1. Between the piston 26 and the inner wall 21 of the housing 2 an annular channel 33 is formed which connects the free space 31 with the partial

inner space 22' facing away from the partial inner space 22" when the damping ring 28 does not apply sealingly against the stop face 29.

Formed in the piston rod 4, coaxially with the axis 5, is a longitudinal channel 34 opening out into the partial inner space 22', which is constituted by a blind hole. This longitudinal channel 34 is connected in the region of its bottom 35 via a throttle channel 36 extending transversely to the axis 5 with the partial inner space 22'. The distance l of this throttle channel 36 from the facing side 37 of the piston 26 is, for example, between 10 and 20 mm.

Mounted on the holding ring 23 is a throttle bush 38 which relative to the piston rod 4 delimits a throttle annular gap 39, the radial extension e of which is 0.02 to 0.1mm, preferably 0.04 to 0.07 mm. The length l' of the throttle bush 38 is at least slightly greater than the distance l, so that the throttle channel 36 is also inside the throttle bush 38 when the piston rod 4 has moved as far as possible out of the housing 2, when, therefore, the piston 26 applies with its side 37 delimiting the partial inner space 22' against the throttle bush 38, as shown in Fig. 2. The throttle bush 38 is in a particularly precisely injectable plastic, e.g, a polyamide.

The inner space 22 of the housing 2 is filed partly with compressed gas 40 and partly with oil 41.

When the piston rod 4 together with the piston 26, on the closing of the boot lid 7, is pushed into the housing 2 with the additional compression of the pressurised gas 40 present in the inner space 22 correspondingly to the pushing position 42 into the housing 2, then the damping ring 28 applies against the stop face 30 of the piston 26. The partial inner space 22" is then freely connected via the annular channel 33, the free space 31 and the passage duct 32 with the partial inner space 22', so that initially the oil 41 and then the gas 40 can flow in a slightly throttled manner from the partial inner space 22" into the partial inner space 22'. The extent to which a throttling takes place is dependent upon the cross-sections of the throughflow

regions mentioned which are selected correspondingly to the requirements dictated by the particular application.

Additionally, oil 41 flows thorough the longitudinal channel 34, the throttle channel 36 and possible the annular groove 39 into the partial inner space 22'. The closing of the boot lid 7 is thus effected against the compressing force of the gas spring 1 which is increasing as a result of the compression of the pressurised gas 40, and indeed in a slightly damped form.

When, on the other hand, the boot lid 7 is opened, the piston rod 4 travels in the pushing position 43 out of the housing 2. In this case, the damping ring 28 applying with light pressure against the inner wall 21 of the housing 2 lies closely against the stop face 29 of the piston 26, so that there is no connection between the free space 31 and the annular channel 33. Thereby there is thus no connection between the partial inner spaces 22' and 22". The only connection is that of the longitudinal channel 34 with the throttle channel 36. At the initial phase of the exhaust movement compressed gas 40 is delivered from the partial inner space along the longitudinal channel 34 and the throttle channel 36 into the partial inner space 22", i.e, the damping is not very pronounced.

When on the further outward displacement of the piston rod 4, therefore with increasing raising of the boot lid 7, the throttle channel 36 communicates with the oil 41, oil is then pressed along the latter and the longitudinal channel 34 into the partial inner space 22" • with the result that from this moment on there occurs an increasing of the damping of the outward movement of the piston rod 4. When the throttle channel 36 on a further outward displacement of the piston rod 4 out of the housing 2 plunges into the throttle bush 38, there occurs an additional hydraulic throttling in the annular gap 39 which increases with the further outward movement of the piston rod 4, as the relative length of the annular gap 39 becomes greater as the insertion of the throttle channel 36 into the throttle bush 38 increases. The dimensioning should be such that the throttle channel 36

plunges into the throttle bush 38 at the latest when the centre of gravity 14 of the boot lid 7 is pivoted inwards over the vertical plane 15. From this moment on, the gas spring 1 is released, as the weight of the boot lid 7 no longer bears upon it, because from this moment on pulling forces are exerted on the gas spring. Consequently, there mush take place a particularly intensive damping of the outward movement of the piston rod 4.

From the above comments it follows that there must be at least sufficient oil in the inner space 22 so that on the plunging of the throttle channel 38 into the throttle bush 38 the partial inner space 22' is fully filled with oil 41, in order that it may be ensured that this end damping is purely hydraulic. As will be seen from the above comments the throttle bush can protrude as far as the inner wall 21 of the housing 2. Therefore, it may also be designed with a very much thicker wall than is shown in Fig. 2.

The embodiment of the invention illustrated in Fig. 3 largely agrees with that of Fig. 2, the application being effected in a manner similar as that shown in Fig. 1. Therefore, all identical parts are denoted by identical figures, and all parts constructionally similar and functionally identical are denoted by the same reference figures with an upper prime, without a renewed description being required with respect to them.

In this arrangement the throttle bush 38' is not rigidly connected with the holding ring 23, but designed as an additional piston. It is connected by means of a helical spring 44 with the damping piston 26' which is secured on the one hand to a projection 45 of the piston 26' delimiting the side 37' and, on the other hand, on the facing end of the throttle bush 38' Thus, there is a tractive connection between the piston 26' and the throttle bush 38'. Between the throttle bush 38' and the inner wall 21 of the housing 2 a throttling annular channel 46 is formed. When the helical spring 44 is released, and therefore when the throttle bush 38' is not applied against the holding ring 23, the throttle channel 36 opens out freely between the side 37' and the

facing end 47 of the throttle bush 38' into the partial inner space 22'.

When the piston rod 4 is pulled out the throttle bush 38' plunges initially into the oil 41, as a result of which a first throttling is effected in the annular channel 46.

Subsequently, the throttle bush 38' comes to rest on the holding ring 23, as a result of which, on the further outward extension of the piston rod 4, the spring 44 is compressed below a counter-force producing a damping. The mutually facing faces 48, 49 of the throttle bush 38' and of the holding ring 23 should in this case lie one on the other substantially in a fluid-tight manner. Subsequently to this, the throttle channel 36 plunges into the throttle annular gap 39 of the throttle bush 38', as a consequence of which the same damping forces are produced as were described above.

CLAIMS:

1. A gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing, on the inner end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel extends in the region of the end of the outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

2. A gas spring according to claim 1, wherein the throttle bush is stationarily mounted in the housing.

3. A gas spring according to claim 1, wherein the throttle bush is connected with the piston by means of a tractive connection.

4. A gas spring according to claim 3, wherein the throttle bush is connected with the piston by means of a helical spring and the throttle channel, when the helical spring is released, opens out into the partial inner space between the piston and the throttle bush.

5. A gas spring according to claim 3 or 4, wherein the throttle bush delimits with the inner wall of the housing, a throttling channel.

6. Utilisation of a gas spring according to any one of claims 1 to 5 as a lifting aid for a hinged panel mounted on a motor vehicle and able to be upwardly pivoted around a joint, the piston rod being downwardly directed in all pivoting positions of the hinged panel with respect to the housing.

7. Utilisation of a gas spring according to claim 6, wherein the central longitudinal axis of the gas spring, when the hinged panel has been pivoted upwardly, encloses an angle in a vertical plane which is less than 65°.

8. Utilisation of a gas spring according to claim 6 or 7, wherein the centre of gravity of the hinged panel, on the upward pivoting thereof, is pivoted through a vertical plane passing through the joint of the panel.

9. Utilisation of a gas spring according to claim 8, wherein the throttle channel extends into the throttle bush when the centre of gravity of the hinged panel is pivoted through the vertical plane.

10. Utilisation of a gas spring according any to one of claims 6 to 9, wherein the housing is filled with an amount of oil such that the partial inner space situated between the piston and the piston rod output side end of the housing is at least substantially filled with oil if the throttle channel extends into the throttle bush.

11. The utilisation of a gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing and on the inner

end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel extends in the region of the end of the outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

12. A motor vehicle having a compartment closable by means of a hinged panel which is upwardly pivotable about a joint assisted by a gas spring with end position damping, comprising a substantially cylindrical housing filled partly with pressurised gas and partly with oil, in which a coaxially disposed piston rod is sealingly displaceable through one end of the housing, on the inner end of the piston there are disposed a piston which closes sealingly on the outward displacement of the piston rod out of the housing and opens on the inward displacement, and a longitudinal channel bridging the piston connecting together the partial inner spaces of the housing situated on both sides of the piston, said longitudinal channel being connected by means of a throttle channel with the partial inner space situated between the piston and the piston rod output side end, and there being provided at the piston rod output side end a device for damping an outward movement of the piston rod in the region of the end of its outward movement, wherein the device for damping the outward movement of the piston rod is formed by a throttle bush into which the throttle channel

extends in the region of the end of the outward displacement of the piston rod out of the housing, a throttle annular space being provided between the piston rod and the throttle bush.

13. A gas spring, substantially as hereinbefore described and with reference to the accompanying drawings.

14. The utilisation of a gas spring, substantially as hereinbefore described and with reference to the accompanying drawings.

15. A motor vehicle having a gas spring, substantially as hereinbefore described and with reference to the accompanying drawings.

Published 1990 at The Patent Office, State House 66 71 High Holborn, London WC1R 4TP Further copies may be obtained from The Patent Office Sales Branch St Mary Cray Orpington, Kent BR5 3RD Printed by Multiplex techniques ltd St Mary Cray, Kent Con 187